**NUCL 325 – Nuclear Materials Laboratory**

**Fall 2016**

*Lecture:* M 8:30 am in GRIS 126

*Recitation:* W 8:30-9:20 am in GRIS 126

*Labs:* M/Tu/W 1:30-3:20 pm in NUCL 111

*Instructor*: Janelle Wharry | jwharry@purdue.edu | NUCL 132C

Office Hours Th 9:00-10:30 am, F 9:00-10:00 am

*TA*: TBD

Office Hours TBD

**Web: https://github.com/wharrygroup/nucl325fall16**

*Course Description & Learning Objectives:*

Nuclear materials laboratory that evaluates various characterization techniques and technologies, tensile properties, hardness, fracture toughness, microstructures, X-ray diffraction, electron microscopy, vacuum technology, mechanical properties of thin-films, and surface characterization techniques

1. Understanding of what materials are, and how they perform and fail.
2. Understand the conceptual tools dealing with materials phenomena.
3. Be able to communicate with professionals about materials problems.
4. Be able to address the limitations of materials in design, and improve them.

*Required Lab Handbook:* NUCL 325 (NUCL 497M) *Nuclear Materials Laboratory.* 5th edition. Can be purchased in **Room 157** of the **Purdue Memorial Union** (Boiler Copy Maker).

*Optional References (Likely Useful):*

* W.D. Callister, Jr., *Materials Science and Engineering – An Introduction,* any edition from the last ~10 years, John Wiley & Sons, Inc.
* G.S. Was. *Fundamentals of Radiation Materials Science: Metals and Alloys*. Springer. 1st or 2nd edition.

*Grading:* Pre-Labs 10%

Quizzes, Assignments 10%

Short Lab Reports (4) 25%

Formal Reports (2) 20%

Final Irradiation Project 15%

Oral Report 20%

A range 90–100

B range 75–89.9

C range 60–74.9

D range 50–59.9

F range <50

*Pre-Labs (10%)*

Must be **typed** and submitted at the **beginning** of Lab session. Failure to submit a Pre-Lab will prevent you from participating in a Lab.

*Quizzes and Assignments (10%)*

Quizzes will be conducted during the first few minutes of Recitation sessions and cannot be made up without prior approval. Assignments will be given throughout the semester and will be collected in lab, or in recitation, as outlined in the schedule or on blackboard.

*Lab Reports (Short 25%, Formal 20%)*

Lab Report submissions must be **typed** and submitted at the **beginning** of Recitation sessions. There are 7 labs (besides the final irradiation project) during the semester. Each student must write 2 Formal Lab Reports and 4 Short Lab Reports during the semester; these 6 written lab reports cannot be from the same Lab that you select for your Oral Lab Report. Each student can choose which labs they will write Formal Reports for, and which labs they wish to write Short Reports for. Each Lab Report must state on the front page whether the student is submitting as a Short or Formal. Specific due dates for each Lab Report are outlined in the schedule. Any changes to the schedule will be posted to blackboard. **Late reports will receive 0% credit. If you are not present at the beginning of lab when the TA collects the reports, your lab is considered late. All lab reports need to be turned in to complete this course.**

*Oral Lab Reports (20%)*

Students work in teams of 2-3 and will present one of the 7 Labs as an oral report during one of the scheduled Recitation sessions. You will not submit a written (Short or Formal) lab report for the lab selected for your Oral Lab Report. Please choose teams based on who you will work with during the lab session in which you are registered (M, Tu, or W). Presentations must be a minimum of 25 minutes, but not to exceed 35 minutes. Content is identical to that of Formal Lab Reports, but must be presented to your classmates using a combination of visual and audio techniques. Any changes to the schedule will be posted to blackboard.

*Final Irradiation Project (15%)*

Due on last Recitation session 12/7. Final Project specifications are defined in the lab manual and throughout the three weeks of the assignment. This project will require much work and cooperation. It will be collected on the final Friday lecture of the semester.

     

Each lab session will be split into smaller groups for experiments. Lab groups should be established during the first week of classes, such that Oral Lab Report selections can be made. **Be sure you are aware of the due dates of your Pre-Labs are you cannot participate in a lab session without turning it in and without attending recitation.** Arrangements can be made with your TA if an emergency arises.

If a situation arises which makes you unable to attend either recitation or lab, you must notify your TA at least 24 hours before that weeks sessions. Make-up labs will be scheduled to occur within the same week of the experiment. Other arrangements can be made in the case of an emergency.

***Semester Schedule***



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| --- | --- | --- | --- |
| **Wk** | **Date** | **Topic** | **Due** |
| 1 | Lec 8/22 | Introduction |  |
| Lab 8/22-8/24 | No Lab |  |
| Rec 8/24 | Introduction to X-Ray Diffraction, Technical Writing, Report Format |  |
| 2 | Lec 8/29 | Error Analysis |  |
| *Lab 8/29-8/31* | *X-Ray Diffraction* | XRD Pre-Lab |
| Rec 8/29 | Tensile Testing, Strain- Gauges, Stress-Strain Curves, Deformation |  |
| 3 | Lec 9/5 | No Class – Labor Day | Error Analysis HW |
| Lab 9/5-9/7 | No Lab – Labor Day Week |  |
| Rec 9/7 | **Group 1 Oral Presentation: XRD Lab** | **XRD Lab Report** |
| 4 | Lec 9/12 | Defects, Strengthening, and Fabrication of Metals |  |
| *Lab 9/12-9/14* | *Introduction to Tensile Testing* | Intro to Tensile Testing Pre-Lab |
| Rec 9/14 | Annealing and Hardness Measurement |  |
| 5 | Lec 9/19 | No Class – JPW Out |  |
| *Lab 9/19-9/21* | *Defects, Strengthening and Fabrication of Metals Lab* | Defects, Strengthening, and Fabrication of Metals Pre-Lab |
| Rec 9/19 | **Group 2 Oral Presentation: Introduction to Tensile Testing Lab** | **Intro to Tensile Testing Lab Report** |
| 6 | Lec 9/26 | Microstructures |  |
| *Lab 9/26-9/28* | *Extrusion, Cold Working, and Strain Hardening Annealing and Rockwell Hardness Testing* | Annealing and Hardness Pre-Lab |
| Rec 9/28 | **Group 3 Oral Presentation: Defects, Strengthening, and Fabrication of Metals** | **Defects, Strengthening, and Fabrication of Metals Lab Report** |
| 7 | Lec 10/3 | Ceramics |  |
| *Lab 10/3-10/5* | *Microstructures: Sample Prep, Grinding, Polishing, and Microscopy* | Microstructures Pre- Lab |
| Rec 10/5 | **Group 4 Oral Presentation: Annealing and Hardness Lab** | **Annealing and Hardness Lab Report** |
| 8 | Lec 10/10 | No Class – Fall Break |  |
| Lab 10/10-10/12 | No Lab – Fall Break |  |
| Rec 10/12 | Introduction to Vacuum Technology |  |
| 9 | Lec 10/17 | No Class – JPW Out |  |
| *Lab 10/17-10/19* | *Properties of Ceramics* | Ceramics Pre-Lab |
| Rec 10/19 | **Group 5 Oral Presentation: Microstructures Lab** | **Microstructures Lab Report** |
| 10 | Lec 10/24 | Radiation damage and characterization |  |
| *Lab 10/24-10/26* | *UHV Systems, Conductance, and Vacuum Regimes Vacuum Leaks, Bake-outs, RGA Chamber Analysis* | Vacuum Technology Pre-Lab |
| Rec 10/26 | **Group 6 Oral Presentation: Ceramics Lab** | **Ceramics Lab Report** |
| 11 | Lec 10/31 | Radiation damage and characterization techniques, thin film growth, experiment preparation |  |
| *Lab 10/31-11/2* | *Imaging Demonstration Lab* |  |
| Rec 11/2 | Radiation Modification of Surfaces and Interfaces |  |
| 12 | Lec 11/7 | **Group 7 Oral Presentation: Vacuum Technology Lab** | **Vacuum Technology Lab Report** |
| *Lab 11/7-11/9* | *Irradiation experiment preparation* | Irradiation Experiment Pre-Lab |
| Rec 11/9 | Thin Film Growth and Characterization |  |
| 13 | Lec 11/14 |  |  |
| *Lab 11/14-11/16* | *Irradiation experiment preparation* |  |
| Rec 11/16 |  |  |
| 14 | Lec 11/21 |  |  |
| Lab 11/21-11/23 | No Lab – Thanksgiving |  |
| Rec 11/23 | No Class – Thanksgiving |  |
| 15 | Lec 11/28 |  |  |
| *Lab 11/28-11/30* | *Irradiation experiment data collection* |  |
| Rec 11/30 | Review |  |
| 16 | Lec 12/5 |  |  |
| Lab 12/5-12/7 | No Lab – Dead Week |  |
| Rec 12/7 |  | **Final Irradiation Project** |

*Emergency Provisions*

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor’s control.

*Academic Honesty*

Be honest in your homework solutions and exams. Exams must be taken without the assistance of others. Cheating will result in a 0 for the exam and reports to your school and the Dean of Students, as required by the University policy.

*Plagiarism*

This course requires a lot of writing. Submitting plagiarized material will result in a zero. Plagiarism is defined by “Academic Integrity: A Guide for Students” (http://www.purdue.edu/odos/osrr/integrity.htm) as:

“...*a special kind of academic dishonesty in which one person steals another person's ideas or words and falsely presents them as the plagiarist's own product. This is most likely to occur in the following ways:*

* Using the exact language of someone else without the use of quotation marks and without giving proper credit to the author
* Presenting the sequence of ideas or arranging the material of someone else even though such is expressed in one's own words, without giving appropriate acknowledgment
* Submitting a document written by someone else but representing it as one's own”